

# How to build community networks in the rural areas all over the world

- *the first 8 steps to get started* -

- **Decide to care for the whole community**  
TAKE THE RESPONSIBILITY
- **Decide to be the one to take initiative**  
MAKE A USEFULL INITIATIV
- **Decide to not depend on anybody specific**  
ACT INDEPENDEND
- **Start researching how to build it**  
SEARCH FOR KNOWLEDGE
- **Make a vision: Where, What, When, How**  
MAKE A MASTERPLAN
- **Organize to share your vision**  
INFORM ALL AROUND
- **Form an inspired group of engaged people**  
ORGANIZE ACTIVISTS
- **Don't wait, go ahead, get real, make a test**  
MAKE AN EXAMPLE

# **Why we need broadband access from rural areas to the global IT-society**

**The standards to be met to make  
a good community network in rural areas**

# **The technical and economical boundaries in a rural area sets the premises on how its community network can be shaped**

- Vast distances, with only few people to pay, makes it close to impossible to finance the wiring or cabling of network connections from big cities to the homes in the rural areas.
- If telephone companies already have wired a rural area, their Internet access are often so expensive that common people cannot afford to pay for it, and a common community network for everybody in the area will then not come along, - and so the people of the area at large will not become part of the global information society.
- On the other hand, a radio based community network only need the radios, antennas and network equipment in each end of a connection, and as this is standardized equipment, it is as cheap as equipment at the end of wired connections. So to spare the digging and wiring, over long distances for only few people, makes radio networks very cheap.
- So as investments in connections over the distances are nil without wires, the building of a whole IT-infrastructure in a rural area, based on radio connections, makes the network so cheap that everybody can afford to participate. This makes rural area community network wireless by definition.

# How to let the network reach out to everybody

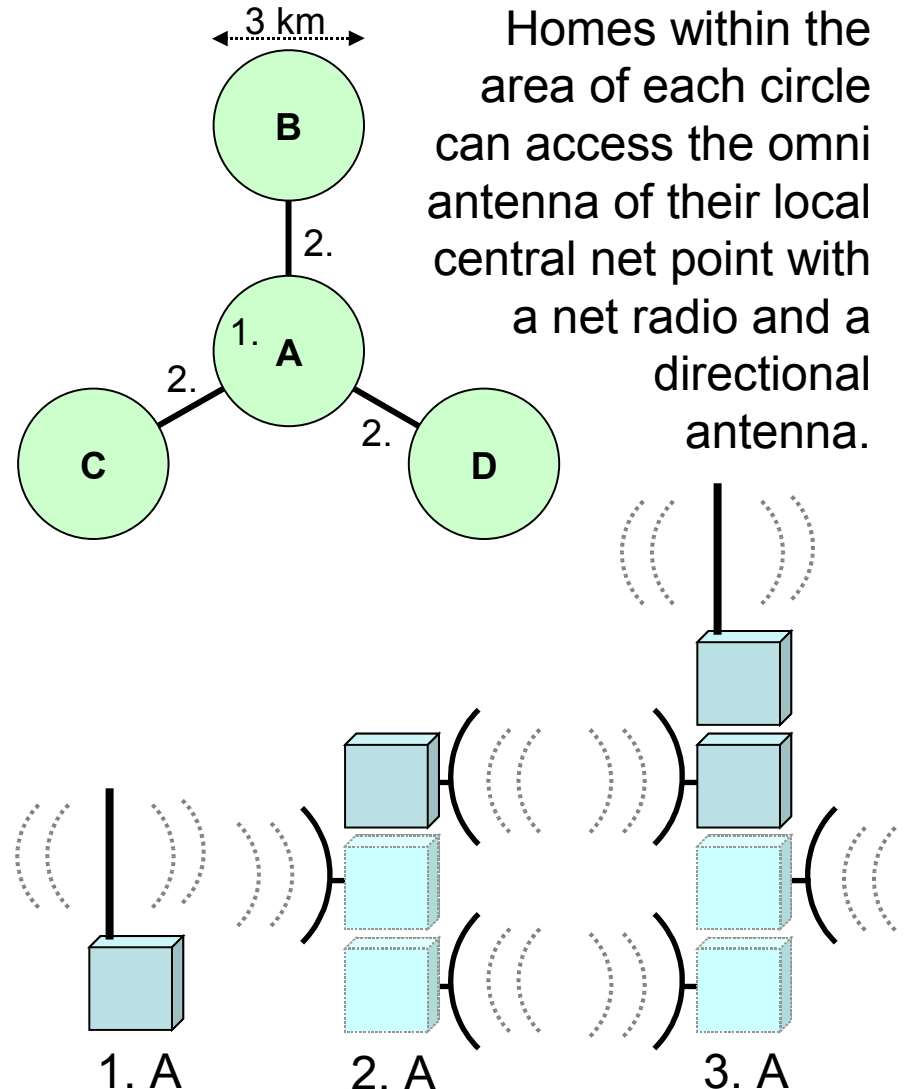
- The rural area needs a huge broadband connection of good quality to the global Internet, delivered by the cheapest possible Internet Service Provider (ISP).
- This Point Of Presence (POP) has to be shared by everybody in the wireless community network everywhere through out the rural area.
- To make each household of the rural area reach this POP to get access out of the area, it is necessary to branch out the radio connections so that everybody in each their area has a local antenna amplified central access point to connect to, with a net radio and antenna for each single household.

# Radios can talk on different frequencies called channels

- The standardized and mass-produced and therefore cheap wireless data radio equipment holds the Wi-Fi standard.
- The IEEE 802.11b and IEEE 802.11g specifications is such standards.
- They both have 12 to 13 different frequencies to use from in the data radio spectrum at the 2.4 MHz band.
- Only up to 4 of these – and with distance between like ch1, ch5, ch9 and ch13 - can be used as radio channels at the same spot simultaneously, without disturbing each other.
- It could be one to connect upward to the Internet by a directional antenna, another to signal to the local area through an omni antenna, and a third - and even a forth - to send forward by each their directional antenna to central placed antennas in two other towns far away.

# The 3 basic equipment modules of an outdoor wireless infrastructure

- Linking center A towards homes (point to multipoint)
- Linking center A towards center B (point to point) and if of use, linking also A towards C and even D (point to point)
- Linking center A towards homes (point to multipoint) **and at the same time** linking center A towards center B (point to point) and if of use, linking also A towards C and even D (point to point). *That is 1. + 2.*



# **Reach and throughput of the antenna signal depends on its strength**

- The signals from the radio is amplified by the antenna when the two are connected by a cable with low resistance.
- The strength or power of the signal is measured in decibel (dB) values or milliwatt (mW) - in different scales.
- For every 3 dB the value of mW doubles.
- In most countries the signal strength from the antenna is limited by law.
- In Denmark the upper limit is 20 dB similar to 100 mW.
- When an omni antenna emits its signal with a power of 20 dB in all directions, its signal reaches out in the area at least as far as 1½ km from the antenna all around. Beyond that distance the background signal noise disturbs a pure signal and makes it difficult to receive it by the households.



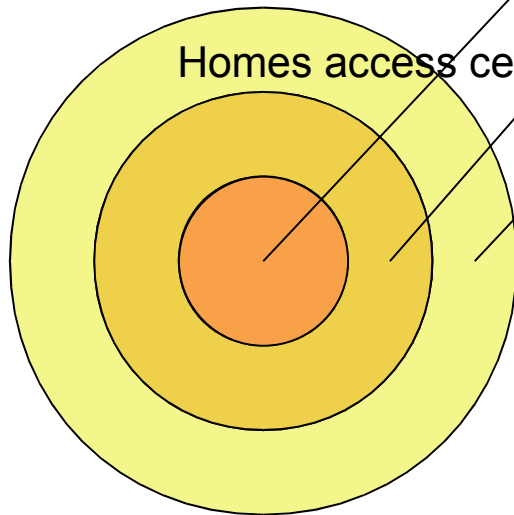
# Reach of an antenna amplified central accesspoint of an area

Homes access central through a "can" antenna

Area seen from above

Homes access central through a "butterfly" antenna

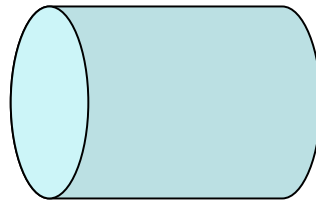
Homes access central through a "can" antenna with a "funnel"



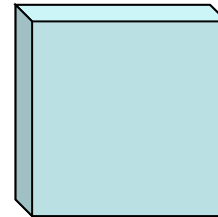
3 km

6 km

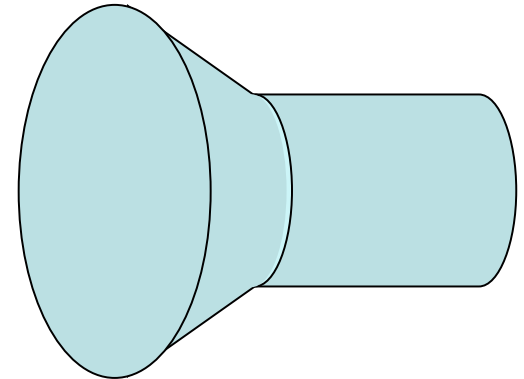
9 km



Can antenna



Butterfly antenna

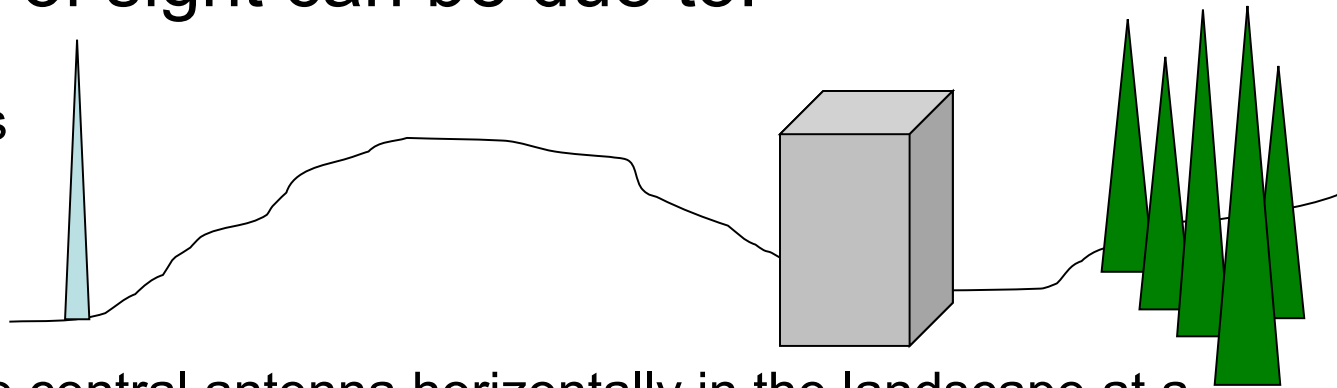


Can antenna with a funnel

# The connection of the radio at a net central and the radio at a home needs **line of sight** between their antennas

- Without line of sight we are without signal
- Lack of line of sight can be due to:

- Hills
- Buildings
- Trees



- **Solution:**

- Place the central antenna horizontally in the landscape at a place viewable from all around.
- And - if possible - place it vertically high on a:
  - » High hill
  - » High building
  - » High tower

# To get the signals through we even need an open “tunnel” around the line of sight

- We have to make sure that there is no obstacles anywhere in a “tunnel” between two antennas, to allow them the full exchange of signals.
- The shape of the needed tunnel is like the shape of a cigar – thickest or widest at the middle.
- This needed free spatial shape is called The Fresnel Zone.
- The wideness of The Fresnel Zone at specific distances between two antennas can be calculated at the following link: [http://www.firstmilewireless.com/calc\\_fresnel.html](http://www.firstmilewireless.com/calc_fresnel.html).
- An example: At the midway between two signaling antennas, placed about  $1\frac{1}{2}$  km from each other, nothing must disturb the traveling signals in a wide space around the line of sight defined by a radius (to the line as a center) of about 4 meters. Not even leaves from a tree !

# How we get beyond big hills, woods, trees and buildings - and how we extends the network to remote areas

- If we cannot get direct line of sight to a local central or to a household due to obstacles in the landscape - or if the distance is too far, we use a middle station, a repeater, preferably two directional antennas with each their interconnected radio, put at a place from where the distance is short enough and from where there are line of sight to both ends.
- This method allow us in a flexible way to get over hills and around woods, trees and buildings and to bridge long distances without losing line of sight or signal strength.
- Technically a wireless chain of radios should normally not exceed 4 links, from wired line all the way out to the single home. If we exceed 4 links and are not careful, we might get a lot of retransmissions of data packets on that network connection, reducing the bandwidth in practical use.

# Base the economy on the users !

- To secure that the network are user owned and user controlled and independent, it is of vital importance that the financing of equipment for the infrastructure and for the households, are solely based on payment from each household of a one time standard fee to get connected.
- When enough households of an area has paid this one time common connection fee, you got the necessary amount of money to invest in the needed infrastructure and user equipment, to make the users of the area establish and connect their own wireless network cell.
- To secure all users full time access to the global Internet, it is equally important that each household pays their common share of the community networks expense to the ISP, as a monthly standard fee to the network for access.

# **Organization of volunteers is an integrated part of a rural area community network**

- To make access to the network so cheap that every body can participate, it will not be possible for a rural area community network to pay wages and yet at the same time keep down expenses. Not until many pays the fee.
- For this reason it is necessary to involve and organize volunteers in all aspect of doings, that is needed to run the rural community network.
- We will need network technicians to organize the locals in the building of the network, and webmasters to make the locals make use of the network for the good of the citizens of the area, and IT-supporters to advice the users about their IT-related problems and - now that we have involved them - how to live in an IT-society, and administrators to care for economy and to organize the different limbs of the organizational body that the community network inevitably will grow amongst the active in the different areas.

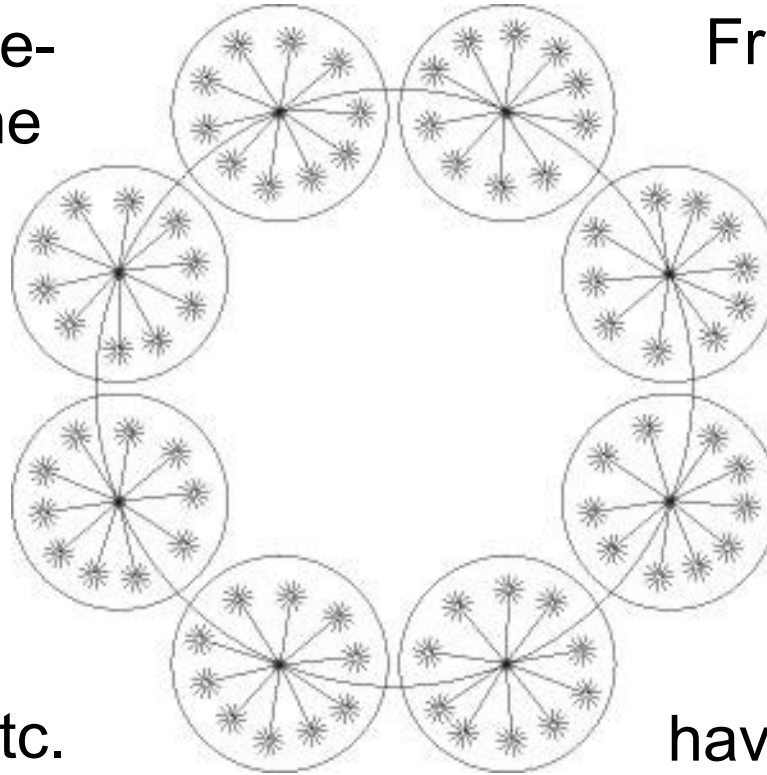
# Net, Web, Support and Organization

- Every local area will naturally – by the power of self interest - get an active group of volunteers who in their own interest engage themselves in establishing and running their own part of the network, for the area where they live themselves.
- Yet many things has to be coordinated and are more rationally done together for all areas, - to make a whole community network, as a building force for the entire local society.
- And for some of those things that every group need to have done, it is actually more likely that it will first be done, when specialized representatives – who are not hung up in other important activities - takes upon themselves to actually do it.
- Experience with building rural area community network has shown, that it is very important, in a simultaneous way, to develop functional limbs for coordination of voluntary activities between all the local groups, in the specialized fields of Net, Web, Support and Organization. Through regional initiatives in all these fields, all the local groups can function coordinated in their local initiatives in all fields. This is fundamentally important for the health of the community network as a whole social body.

# The community network infrastructure

In this simplified drawing the 8 small circles represents the local networks and organizations in each of 8 municipalities.

The big circle represents the backbone of the network which interconnects the municipalities. The backbone can be a fiber connection cables or wireless high speed links etc.

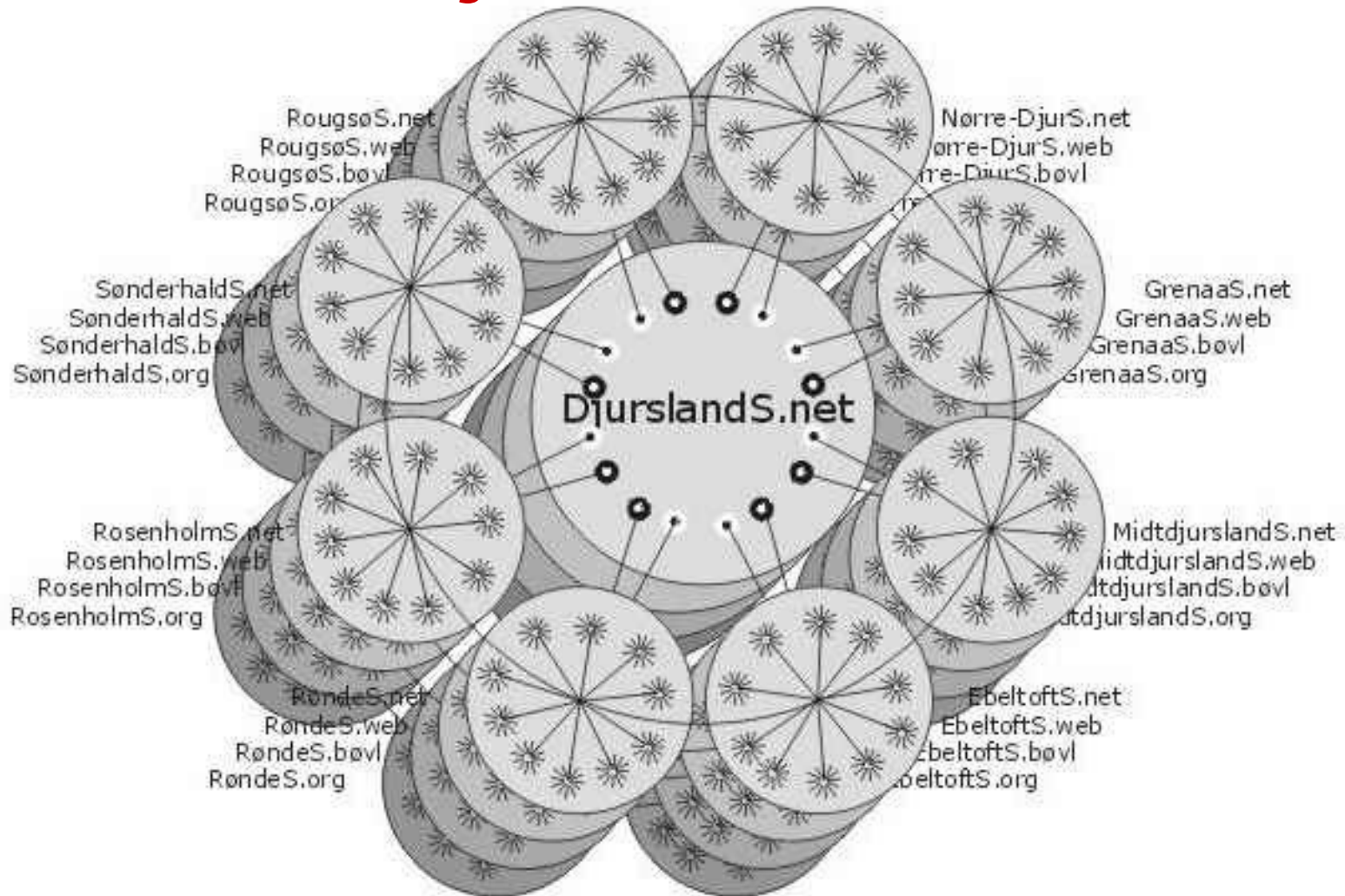


From each municipal circle center, high speed wireless links make connections to the center point of each town, and through this all the single homes have full time access.

Organizationally the group of volunteers in each city should be represented in a municipal board, which should have its representation in a regional board for the whole community network.

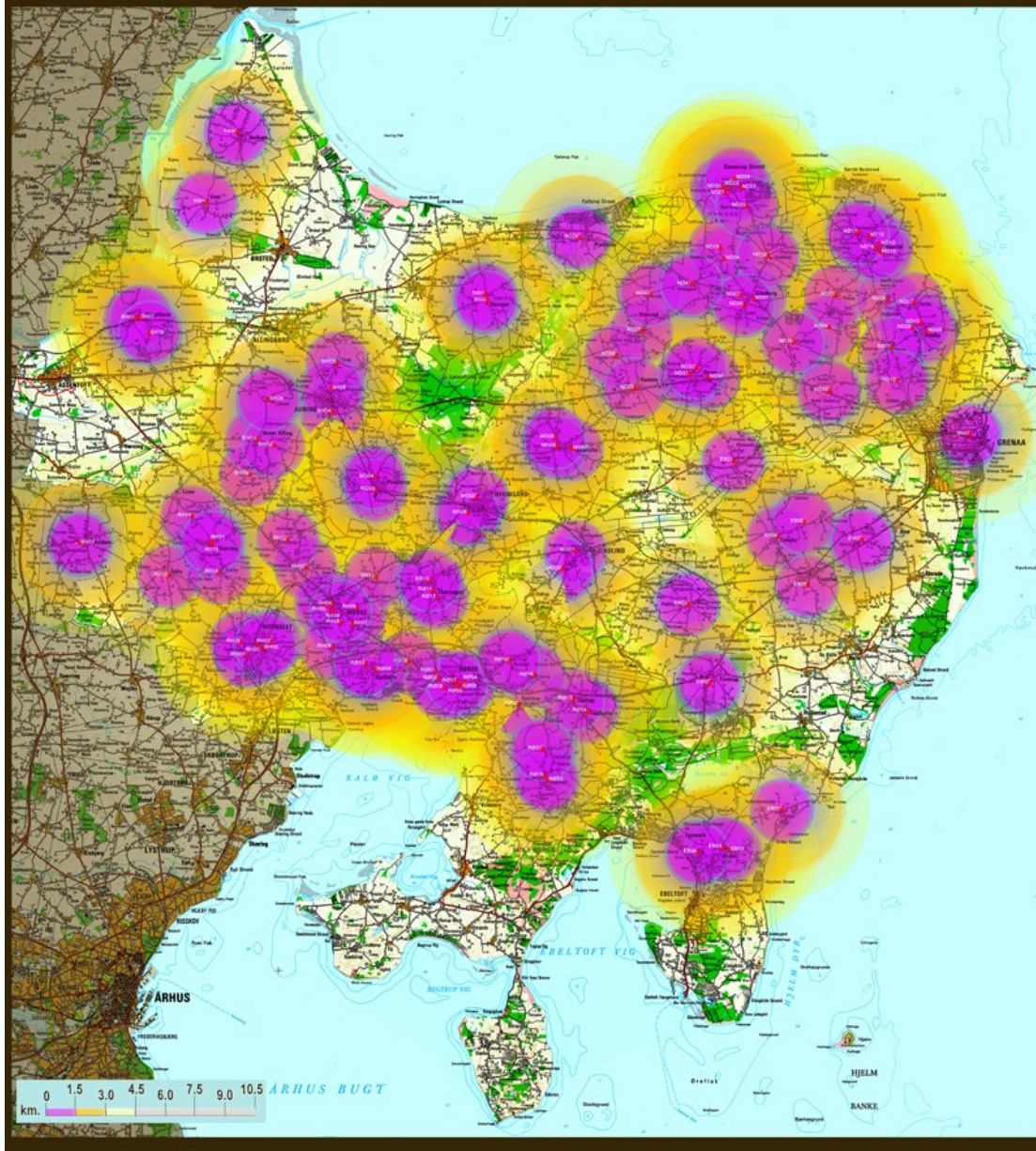


# This is how DjurslandS.net was build



The board of each municipal network had coordinators for net, web, support and organization (the four layers) and met with their colleges in regional boards for each subject (in the middle).

# Radio covered areas of DjurslandS.net



From spring 2003 until spring 2005 the local active groups all over Djursland established wireless netcovering in more than 150 areas, giving actual access to the citizens in more than 2.500 households, and this speedy growth continues.

The 8 municipals of Djursland has about 82.000 citizens in about 36.000 households. And gradually a rural IT-society will develop.



# How the vision came along on Djursland

- The vision of a free - or at least very cheap - radio based (wireless) broadband landscape network for everybody on Djursland, has developed since 1991 out of very good experiences with a wireless and already then complete computer network, based on the data packet radio techniques.
- During the nineties a few computer freaks was connected for free, full time through out the landscape, in spite of the big distances. The only lack was the lack of speed – only 1.200 bit pr. second, but then again speed was OK for up and download, and for chat rooms etc. - if you didn't use a graphical user interface.
- While the use of paid Internet access through wired connections came along there was a very long wait for the development of more speedy data radio equipment, which would be cheap enough for common people. Other techniques were explored during the waiting.
- By the year 2000 data radios had reached the level of broadband, and need for standardization arose in the horizon to prepare for mass production, so cheap equipment could soon be expected. Knowing this, a preparation group for the wireless people's free network on Djursland was formed in February 2000. This initiative lead to the establishment of DjurslandS.net, with all its interconnected local outdoor wide area broadband networks everywhere on Djursland.

# The strategy of making the DjurslandS.net

- The strategy for the establishment of a free wireless people's network on Djursland was, right from the vision was born in 1991, to create a broadband IT-infrastructure for everybody, to be able to develop Djursland as an IT-society, making up a virtual motor for development in ALL fields of life, in this rural area.
- Based on experiences from the network of computer users, which has developed from the northern Djursland since 1991, part of the strategy has always been four fold:
  1. Lightning fast local-, municipal- and regional outdoor wide area wireless free network, with the cheapest possible fixed price broadband access to the global Internet.
  2. An common web portal for everyone with an all sided news stream from and to the local-, municipal- and regional society.
  3. Friendly mutual help with all kind of IT-related problems for every citizen in all areas of Djursland, based on telephone support and scheduled local workshops in all municipals.
  4. Inspiring, organizing and coordinating skilled volunteers around all the many jobs, which has to be attended to in a well functioning rural area community network of this size.
- The goal has all the time also been to make free VoIP possible within Djursland - based on peoples ordinary telephone handset, and to build the foundation of remote home based e-work, e-learning, local TV etc.

# Formalize organizational matters to keep volunteers on track of goals

- To make everybody - who involves themselves as volunteers along the road - synchronize their actions with the goals, rules and strategies, and also to exclude a lot of differing in opinion etc., it is extremely important for the survival of the project, that goals, rules and strategies, both are collectively decided and that they also are written down, as a respected foundation and as agreements to be kept by everybody, for real.
- It is as important that ALL newcomers - without any exception - has to be trained not only in technical matters, but also in ALL the principals of the foundation and the agreements - rules etc. - before they are given any kind of responsibility, what so ever.
- All who get influence should sign a declaration of responsibility.
- For the organization to stay independent it is vital that no single job should be allowed to depend on any single person.
- And to stay unified, economical matters should never be allowed to be handled by decentralized limbs of the whole unified community network body.

# **How to keep a pure track and prevent evolvement of swindle**

**Volunteers contra staff members  
and staff waged by users or by others**

**Enroll subscribers to start an area**



# Collecting the necessary equipment

# **Configuring equipment for infrastructure and for households**

# Setting up infrastructure equipment

# Handing out equipment to households

**To inform about how to get support  
and how we secure a useful support**

**Support information at web portal**

**Support at scheduled times at workshop**

# **Different applications of the network for life in the rural area society**



# Running the web portal as public interest

**Supporting firms, businesses, institutions  
and leisure time activities in rural areas**

# Rural remote education by e-learning

# The elder people in rural area IT-society

# **The life of children in rural areas and the importance of access to the global IT-society**

**The story of life in the rural area  
accessible through the electronic window**

# Supporting the tourists visiting the rural area

**Working for the world right at home**



# **National and international exchange of experience, knowledge and ideas**

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# Developing the community network

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# Advanced configuration of the network

# Services for the community

# **Volunteers, free software and building free networks**

# Workshops for net, web and support

# Teaching of volunteers

# **An International Institute for Rural Wireless Broadband**



# **Supporting establishment of rural community networks around the world**

# **Definition and development of rural projects through students at the International Institute**

**Remote teaching from the institute on  
“community network and development”  
to people in rural areas around the world**

# How to get started building wireless

## A. Field studies in the areas to be connected:

- Horizontally: localize central positions in areas to be wirelessly covered.
- Vertically: Localize heights, hills, masts, towers, buildings etc.
- Directions: Find possible interconnections to and from the high central points considering fresnel zones.
- Distances: Consider signal strengths.

## B. Tools to take with you in the field:

- Map: To recognize what you see in reality compared with what the map shows.
- Binoculars: To study distant objects and line of sight to possible other points.
- Camera: Make photos of surroundings and 360° around sender spots.
- Paper and Pen: Take notes of observations, inspirations and ideas in the field.

## C. Agreements to be made:

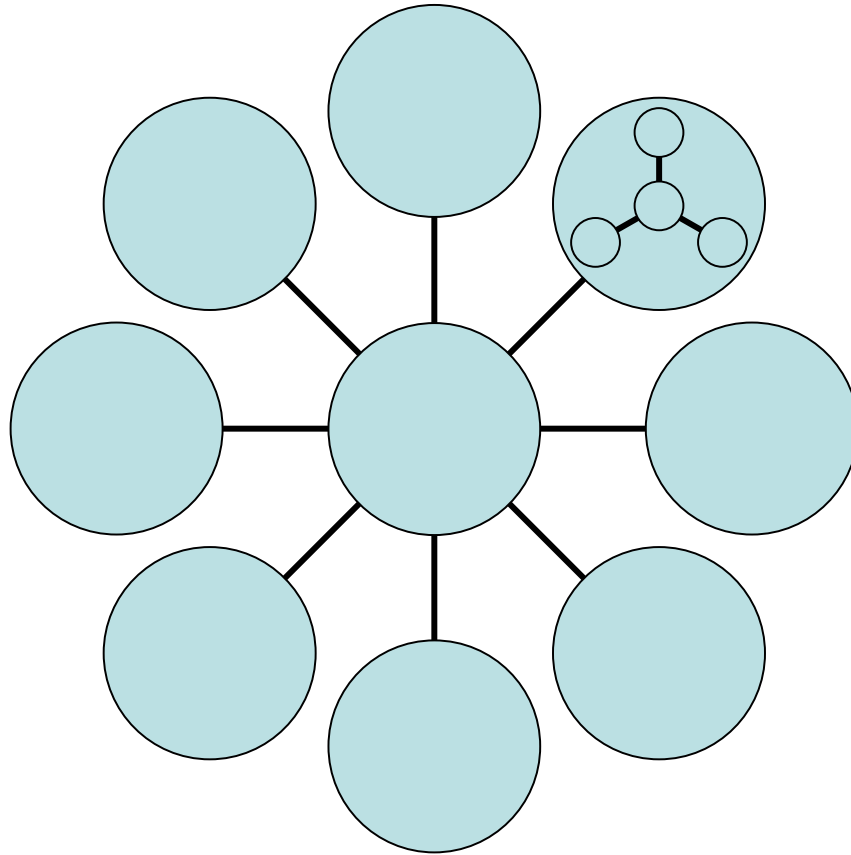
- Get appointments: To arrange Internet access to the area and placements for senders.
  - a) Prepare description of the needed equipment making it feasible.
  - b) Prepare drafts of contracts for mutual adjustments and signing.
- Allowances: Create the necessary good relationship with the authorities.
  - a) Keep the laws.
  - b) Get appointments and meet with authorities and give them the good vision.
  - c) Formulate and forward applications and draw the strings of influence in the community.
- Interest: Arrange public meetings to let people become interested.
  - a) Use the media to tell about the good vision and about the introduction meetings.
  - b) Inspire people at meetings, tell what the cost is and have them sign a declaration of interest.
  - c) When enough people have signed for access in the area, have them pay their contribution.
  - d) Buy the necessary equipment for infrastructure and for users.
  - e) Prepare all equipment, put up the infrastructure and lend out the user gear with guiding notes.

# Hvordan starter man et trådløst net ?

- **Studier i felten i de områder der skal forbindes:**
  - Horisontalt: lokaliser centrale positioner i de områder der skal have trådløs dækning.
  - Vertikalt: Lokaliser høje steder, bakker, master, tårne, bygninger osv.
  - Retninger: Find de mulige forbindelseslinier til og fra de høje centrale punkter, under hensyntagen til "fresnel zoner".
  - Afstande: Vurder signal styrke for de mulige afstande.
- **Redskaber der skal medbringes i felten:**
  - Landkort: For at knytte indtryk af virkeligheden til det som kortet viser.
  - Kikkert: For at studere objekter i det fjerne og sigtelinier til mulige andre punkter.
  - Digitalkamera: Lav fotos af omgivelser og 360° panorama set fra mulige sendepunkter.
  - Papir and blyant: Tag noter af observationer, inspirationer og idéer i felten.
- **Aftaler der skal skabes:**
  - Lav aftaler: For at arrangere Internet adgang til området og placeringer for sendere.
    - Udform beskrivelse af det nødvendige udstyr på en måde der gør det rimeligt.
    - Udform udkast til kontrakter beregnet til gensidig tilpasning og underskrift.
  - Tilladelser: Skab de nødvendige gode relationer til til autoriteterne.
    - Hold de gældende love.
    - Lav aftaler og gennemfør møder med autoriteterne og giv dem den gode vision.
    - Formuler og send ansøgninger og få indflydelsesrige personer til at trække i lokalsamfundets tråde.
  - Interessedannelse: Arranger offentlige møder for at gøre folk interesserede.
    - Brug medierne for at fortælle om den gode vision og om tid og sted for introduktionsmøderne.
    - Inspirer folk ved møderne, fortæl hvad det koster og lad dem skrive sig på en liste for interesserede.
    - Når nok mennesker i et område har tilkendegivet interesse, så lad dem betale deres indskud.
    - Køb det nødvendige grej til infrastrukturen og til brugerne.
    - Klargør al grej, opsæt infrastrukturen og udlån brugergrejet, - vedlagt "gør det selv" vejledende noter.

**Building many-sided relationships and  
caring for the network behind the network**

# Laying out the channel selection

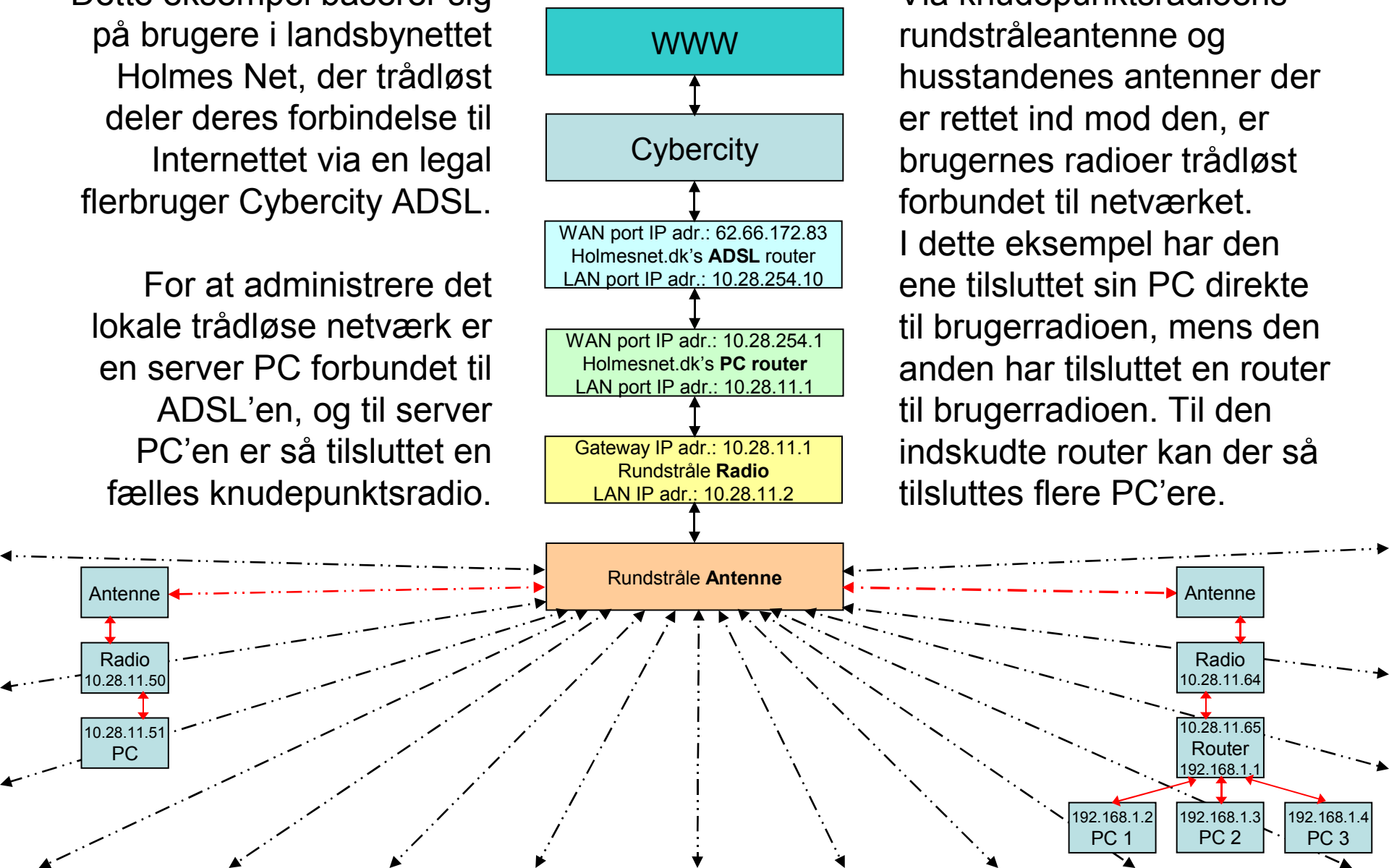


# Forbindelsen mellem WWW og bruger

Dette eksempel baserer sig på brugere i landsbynettet Holmes Net, der trådløst deler deres forbindelse til Internettet via en legal flerbruger Cybercity ADSL.

For at administrere det lokale trådløse netværk er en server PC forbundet til ADSL'en, og til server PC'en er så tilsluttet en fælles knudepunktsradio.

Via knudepunktsradioens rundstråleantenne og husstandenes antenner der er rettet ind mod den, er brugernes radioer trådløst forbundet til netværket. I dette eksempel har den ene tilsluttet sin PC direkte til brugerradioen, mens den anden har tilsluttet en router til brugerradioen. Til den indskudte router kan der så tilsluttes flere PC'ere.





# **9 disciplines to be cared for to run a community landscapenet:**

- 1) Organizing
- 2) Campaigning
- 3) Administration
- 4) Equipment and tools
- 5) Net-planning- and building
- 6) Web-portal building and maintaining
- 7) User-support and sustain of net
- 8) Handling of routers and servers
- 9) Documentation and evaluation

# **7 discipliner der skal varetages for at kunne drive et folkenet:**

- 1) Organisation
- 2) Administration
- 3) Grej og værktøj
- 4) Net-planlægning- og byggeri
- 5) Web-portal- byggeri og drift
- 6) Bruger-support og drift af net
- 7) Håndtering af routere og servere